

California Marine Life Protection Act Size and Spacing Analyses

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Two goals of the Marine Life Protection Act deal primarily with issues related to the persistence of marine populations. Goal 2 focuses explicitly on the dynamics and persistence of marine populations:

MLPA Goal #2: "To help sustain, conserve, and protect marine life populations, including those of economic value, and rebuild those that are depleted."

Goal 6 focuses on the collective function of the collection of MPAs:

MLPA Goal #6: "To ensure that the state's MPAs are designed and managed, to the extent possible, as a network."

Meeting these two goals was the stimulus for the size and spacing guidelines in the Master Plan Framework (MPF). With respect to MPA size, the MPF specifies two guidelines.

Size Guideline #1: "For an objective of protecting adult populations, based on adult neighborhood sizes and movement patterns, MPAs should have an alongshore span of 5-10 km (3-6 m or 2.5- 5.4 nm) of coastline, and preferably 10-20 km (6-12.5 m or 5.4-11 nm). Larger MPAs would be required to fully protect marine birds, mammals, and migratory fish."

This size guideline arises primarily from data on the movement of adult and juvenile fish and invertebrates. Since MPAs will be most effective if they are substantially larger than the distance that individuals move, larger MPAs provide benefit to a wider diversity of species. A summary of existing scientific studies of adult movement (See Appendix 1) shows that adult movement varies greatly among California's marine species (Table 1). Therefore the choice of any MPA size determines the subset of species that could potentially benefit. For species with average movement distances of 100s to 1000s of miles, MPAs are unlikely to be a source of significant protection (except when they protect critical locations, e.g., spawning or nesting grounds). As a result, the MPF guidelines focus on species in the first three movement categories in Table 1. The minimum size guideline of 5 to 10 km targets species in the first two categories. The preferable 10 to 20 km size range attempts to provide substantially more benefit to the important group of species in category 3 (10 - 100 km movement). This group includes a number of important rockfishes from the California coast. Therefore, MPAs that meet the preferable size guideline should protect more biological diversity than MPAs that just meet the less stringent minimum guideline.

Table 1. Scales of adult movement for California coastal marine species

The second size guideline arises from an attempt to connect habitats across depth ranges. Many marine species spend different parts of their life cycle in different habitats

0 – 1 km	1 – 10 km	10 – 100 km	100 – 1000 km	> 1000 km
Invertebrates Abalone Mussel Octopus Sea Star Snail Urchin Rockfishes Blk. & Yellow China Gopher Kelp Other Fishes Gobie Sculpin * Seasonal Migration	Rockfishes Black Brown Copper Greenspotted Olive Vermilion Other Fishes Cabezon Ca. Halibut Lingcod 	Invertebrates Dung. Crab* Rockfishes Bocaccio Canary Yellowtail Widow Other Fishes Anchovy Herring Sardine Birds Gulls Cormorants Mammals Harbor Seal Otter	Fishes Big Skate Pacific Halibut Sablefish* Salmonids* Sturgeon Whiting* Birds Gulls* Mammals Porpoises Sea Lions*	Invertebrates Jumbo Squid* Fishes Sharks* Tunas* Turtles* Birds Albatross* Pelican* Shearwater* Shorebirds* Terns* Mammals Dolphins Sea Lions* Whales*

that often span a range of depths. By connecting these different habitats in a single MPA, species that move among contiguous habitats will likely benefit. Hence,

Size Guideline #2: “For an objective of protecting the diversity of species that live at different depths and to accommodate the movement of individuals to and from shallow nursery or spawning grounds to adult habitats offshore, MPAs should extend from the intertidal zone to deep waters offshore.”

This guideline reflects the recommendation of the SAT that MPAs extend from the shore to the boundary of state waters (3 miles). Extending MPA boundaries to the edge of state waters has the added benefit of allowing for connections with future MPA designations in federal waters. The combination of these two size guidelines forms the basis for SAT evaluation of MPA areas that use both the alongshore and offshore dimensions.

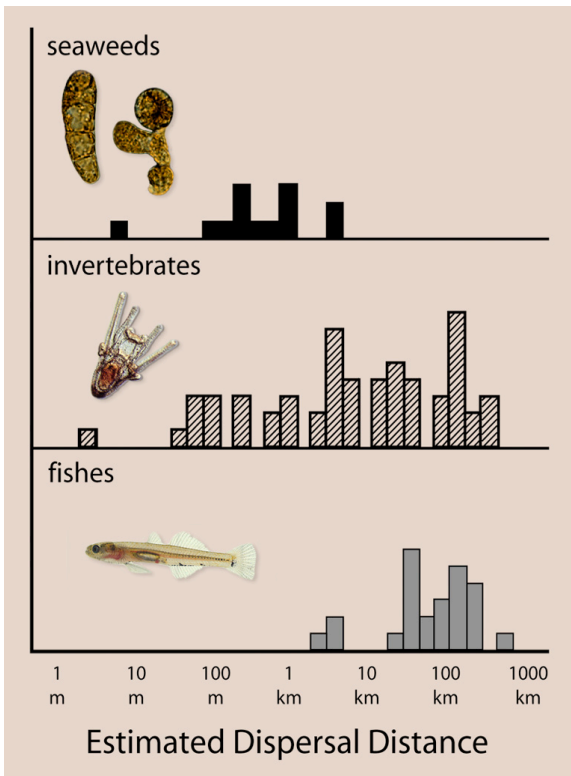
Methods of SAT analysis of MPAs relative to these size guidelines:

- We measured the alongshore length and area of each proposed MPA

- When MPAs shared boundaries, we combined contiguous MPAs into a single MPA cluster
- We considered the level of protection in each component of an MPA cluster
- We tabulated the sizes of all MPAs and MPA clusters with respect to the MPF minimum and preferable guidelines.
- We considered which habitats were represented in MPA clusters that meet MPF minimum and preferable guidelines.

The MPF has one key spacing guideline related the maximum distance between MPAs for the diversity of habitats in the Central Coast.

Spacing Guideline #1: “For an objective of facilitating dispersal of important bottom-dwelling fish and invertebrate groups among MPAs, based on currently known scales of larval dispersal, MPAs should be placed within 50-100 km (31-62 m or 27-54 nm) of each other.”



This guideline arises from a number of studies that examine the persistence of marine populations with a network of marine reserves (Botsford *et al.* 2001, Gaines *et al.* 2003, Gaylord *et al.* 2005) and its connection to larval dispersal. The spacing distances arise from a number of recent syntheses of data on larval dispersal in marine fish, invertebrates and seaweeds (Shanks *et al.* 2003, Kinlan and Gaines 2003, Kinlan *et al.* 2005) and advances in modeling of larval transport (e.g., Siegel *et al.* 2003, Cowen *et al.* 2006). As with adult movement, scales of larval movement vary enormously among species (meters to 1000s of km – Figure 1). In contrast to adult movement, however, it is the short distance dispersers that pose the biggest challenge for connections between MPAs.

Figure 1. Scales of larval and spore dispersal as estimated from population genetic structure of species with relatively sedentary adults but dispersing young (Kinlan and Gaines 2003).

Methods of SAT analysis of MPAs relative to these spacing guidelines:

- Since the spacing guidelines are targeted at ensuring connectivity among MPAs for different species, MPAs must be characterized by the habitats they contain. An MPA that does not contain habitat for a particular species (e.g., kelp forest), provides no benefit to that species. Therefore, we calculated the amount of each habitat (i.e., area or linear distance) in each MPA.
- We then calculated the % of the MPA that each habitat represents. For kelp forests, we calculated the % of shallow water habitat (<30m) only, since kelp does not grow in deeper waters.
- An MPA was considered to include a specific habitat if that habitat represented more than a critical fraction of the entire MPA. For common habitats (e.g., rocky intertidal, sandy beach, surfgrass/eelgrass, sand 0 to 30m), we used a threshold of 20% of the MPA. For rarer habitats, we reduced the threshold to either 15% (sand 30 to 100m, rocky reef 0 to 30m) or 10% (kelp forests, sand > 100m, rocky reef 30 to 100m). For the upwelling center habitat category, we counted all MPAs that included shallow and moderate depth habitats in the vicinity of the four major upwelling centers of the central coast – Año Nuevo/Davenport, Pt. Sur, Pt. Buchon, Pt. Arguello/Pt. Conception.
- The use of %s to define which habitats are present in a significant amount presents two problems. First, for small MPAs, even a large fraction of the MPA may represent an insignificant amount of habitat. We believe this problem can be adequately addressed by the MPA size analyses. Second, for large MPAs, even a large area of a particular habitat may represent a small percentage of the MPA. Since larger MPAs have substantial benefits as discussed above, we developed an alternative criterion based upon habitat area *per se*. We considered any habitat that represents more than 2 square miles of habitat within any MPA to be present in a meaningful amount for spacing analyses. This area was chosen based upon patterns of adult movement (see Appendix 1).
- For each habitat we determined the spacing between all MPAs that included that habitat.
- We compared these spacings to the maximum spacing guidelines in the MPF.

Citations

(see Appendix 1 for citations on Adult Movement)

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